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November-December 1952

METAL TREATING

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METAL TREATING INSTITUTE

THE *Only* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

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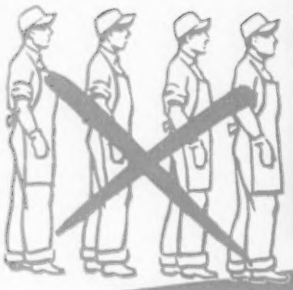

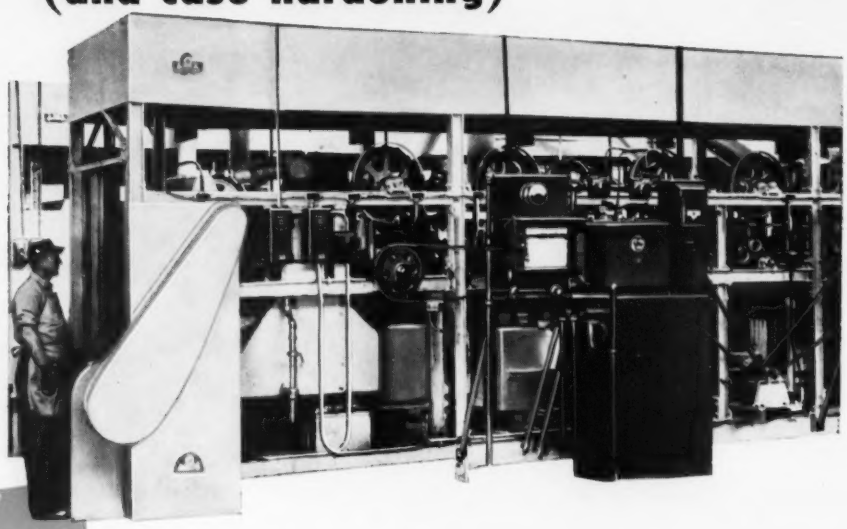

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ELECTRIC SALT BATH FURNACES

Editorial...

THE NEW IDEAL

The recent national election closed one important period of American history and opened a new one.

Political leaders have been changed, and with them certain political policies. Americans had a chance to express their views and did so.

While this represents an emphatic rejection of Socialistic tendencies in government, and a revulsion against centralized bureaucratic control, it plainly is not a mandate for turning back the clock, abandoning social gains or licensing the incoming party to missuse its power.

America has underwritten the ideal of free competitive enterprise as opposed to bureaucratic interference; the principle of equality and cooperative between all classes as opposed to class warfare, and the standard of simple uncompromising honesty toward all people as opposed to special privilege for any selected group.

America's two-party political system has once more revealed its strength in time of crisis.

All thinking people will realize that this return to basic American ideals presents a challenge to us all; not only to those newly elected to office, but even more to the business men, industrialists, wage earners and white collar groups to do their part individually and collectively to make our chosen system work. We must make our light shine as a beacon for all the world. We must show that free people are strong people. If we muff this opportunity we may never have another. Let's play ball. Let every one of us accept the responsibility of doing our individual part to support the New Ideal.

H. C. K.

In spite of the serious note, we want to repeat the time-worn but sincere wish for peace and happiness for all.

Merry Christmas and A Happy New Year

METAL TREATING

Official Journal of the Metal Treating Institute

National Trade Association of Commercial Heat Treaters

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Twentieth Century Innovations in Heat Treating

By Dr. Bradley Stoughton *

Dr. Bradley Stoughton

For tens of centuries steel was hardened by heat treatment in making swords, spears, shields and cutting tools. But more advances have been made in the first half of the Twentieth Century than in all preceding history. This was partly due to foundations laid by earlier workers, partly to the increasing demands of industry, railroads, automobiles, airplanes and armaments, and particularly to the modern scientific approach to the problems of metallurgy.

Outstanding innovations occurring during the last fifty years include—

1. Definite conversion of heat treatment from an art to a science.
2. Heat treatment of steel and other metals for strength and toughness as well as hardness.
3. Development of high speed steel.
4. The use of alloying elements to confer deep hardenability, toughness at high strength, milder quenching, resistance to chemical attack (stainless steels), improved properties at high and low temperatures, and many other special properties.
5. Heat treatment of cast iron and steel castings.
6. Differential local heating for hardening or annealing, instead of differential chemical composition (variation in carbon).
7. Induction heating.
8. Nitriding.
9. Cementation by silicon.
10. Powder metallurgy.
11. Heat treatment of aluminum alloys, cast and wrought.
12. Development of numerous age-hardening nonferrous alloys.

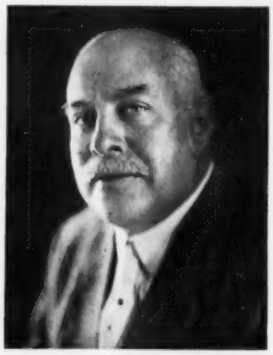
IMPROVEMENT OF EQUIPMENT AND TECHNIQUE

Furnaces

Marvelous results were obtained by the old blacksmith and heat treater, but their skills in judging temperatures have been vastly improved upon by modern temperature control and automatic operation. Electric furnaces were, perhaps, the first to be automatically controlled, but this has now been extended to all types.

Mechanization in the heat treatment of continuous lots as in roller hearths, rotary hearths, screw and belt-conveyors, shaker hearths and the like not only lessen labor employed, but improve control and uniformity. The recent batch type furnaces having closely regulated artificial atmosphere have contributed greatly to economy in the treatment of small parts. Flame heating, manual or mechanized, is successfully used for local hardening or annealing. Developments in heating by electrical high frequency induction have been remarkable.

Pyrometers



George Kimball Burgess, 1874 to 1931

An outstanding scientific metallurgist and an authority on the measurement of high temperatures (pyrometry). He was active in establishing and building up the metallurgical division of the U.S. Bureau of Standards, and was Director of the Bureau from 1913 until his death.

Along with the improvements in furnace design came that of pyrometers. The modern electronic controlling pyrometer is a wonderful instrument and is a far cry from early methods of measuring temperature such as Wedgewood's balls of clay, Seger's cones, various expansion pyrometers, Siemen's water pyrometer, leChatelier's thermo-electric pyrometer (1886) and his optical pyrometer (1892). The two latter methods of measuring temperature have been highly developed. Radiation pyrometers have also reached a high state of efficiency. All of these things have permitted accurate control of heat treating temperatures over all ranges.

Testing the Product

High performance requirements and mass production during the Twentieth Century have placed great importance upon quality and uniformity of product. Many methods of testing have been developed including destructive and non-destructive. These include the microscope, tensile tests, hardness, impact, and fatigue tests, measurements of hardenability and the like, with magnetic testing both for quality of metal and for

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* *Condensation of Address by Dr. Bradley Stoughton Delivered before the Spring Meeting of the Metal Treating Institute, Lake Placid, May 23, 1952.*

Limitation of space unfortunately prevents publication in full.

Bradley Stoughton is well known as one of the deans of metallurgy, both in this country and abroad. He is retired head of the Department of Metallurgy of Lehigh University; author of a well-known text—METALLURGY OF IRON AND STEEL, and other books and papers; past President of the American Society for Metals, long prominent in American Institute of Mining and Metallurgical Engineers and Iron and Steel Institute; a director of Lukens Steel Co. and represented the United States Government in the defense effort at home and abroad in World War II.

flaws in steel, penetrants for the detection of cracks, crevices and so forth.

It is interesting that as far back as 1860 to 1870 Wöhler, Fairbarn, Spangenberg and Bauschinger made tests of hardness, fatigue and impact. Somewhat later Charpy began to develop his impact apparatus.

The file test has been used from time immemorial. Various scratch tests for hardness were common in the Nineteenth Century. Today the Brinell, the Shore scleroscope, the Vickers and the Monotron, as well as the Rockwell Tester, are widely employed to verify the properties of metal parts without destruction.

Albert Sauveur, 1863 to 1939

Did pioneering work in America in the microscopic examination of metals; established and was editor of "The Metallographist." Due to his inspiration and instruction many physical metallurgists are now doing outstanding work.

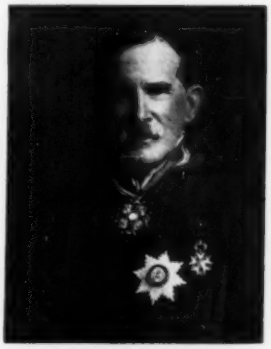
Microscopes

The microscope is a fundamental, indispensable tool of the modern metallurgist. Sorby, in 1863, laid the foundation for this art which not only revealed characteristics of steel and other metals heretofore unsuspected, but contributed enormously to a better understanding of the changes brought about by heat treatment. Sorby's "high power" microscope of 60 diameters has been replaced by instruments and technique giving magnifications of 1000 to 2500 diameters. But the electron microscope with its capacity for high power magnification up to as high as 50,000 or even more diameters, has opened an entirely new field. Improvement in instruments has been accompanied by improvement in technique including electrolytic polishing, color photography, special coatings and light filters, better illumination, better mountings.

Quenching

Until the present century remarkable and mysterious properties were attributed to quenching media. Many quaint formulae were given including special oils, waters, wines, urine of men and animals, concoctions of earthworms and radish roots, as well as more practical mediums including liquid lead, molten salts, mercury and water spray.

Today a better understanding of the mechanism of cooling metals through their surface and means of controlling the rates of cooling have contributed vastly to the heat treating art. Much still remains to be learned on this subject.



Henry Marion Howe, 1848 to 1922

For twenty years before his death he was known as the Dean of World's Iron and Steel Metallurgists. By his writings and researches he inaugurated the conversion of the heat treatment of steel from an art to a science.

"Delayed quenching" was practiced without much understanding until Bain and Davenport in 1930 developed the so-called S-curves with their accompanying light upon the hardenability of various steels and the means for developing various microstructures with their corresponding physical properties.

Edgar Collins Bain, 1891 to ——

His discovery and publication (with Edmund S. Davenport—1897 to ——) was the final step in the conversion of the heat treatment of steel from an art to a science.

Nitriding

One of the distinctive developments of the Twentieth Century is surface hardening by means of dry ammonia. The presence of certain alloying elements, notably chromium, molybdenum, and for maximum hardness, aluminum, is essential for best results. These special alloys are first heat treated by quenching and tempering to a reasonably high core hardness and strength, stabilized by stress annealing if necessary, finish machined and then nitrited by heating in commercial anhydrous ammonia for a long period which may vary from a few to a hundred or more hours, depending upon the depth of case desired. The work is then allowed to cool naturally in the furnace. The resulting case is exceedingly hard and wear resistant and has various remarkable properties, including retention of hardness at moderately elevated temperatures, anti-friction qualities and mild resistance to corrosion. The elimination of quenching in the surface hardening operation avoids deformation which must accompany hardening by carburizing or other treatments.

Education

A better understanding of the science of metallurgy has accompanied, and in fact permitted, an advance in almost all fields of modern industry, as well as in the weapons of defense. The demand for trained metallurgical men, today, has far out-run the supply. An increased fund of scientific knowledge has placed a greater burden upon those trained in the metallurgical field as well as creating an expanded opportunity.

Distribution of Information

One of the important advances of the present century which accounts, in large measure, for the tremendous increase of scientific knowledge and its application is the distribution of information through the medium of technical societies, trade organizations, technical magazines and other publications. It is recognized that the exchange of information benefits all, and is far better than the old notion of passing secrets of the trade from father to son.

Zay Jeffries, 1888 to ——
Published the "slip-interference theory" and several other suggestions which helped to establish the heat treating of metals on a scientific basis.

We must admire the skill and technique of those, who for many centuries, practiced the heat treating of metals as a secret art. Their skill was often ascribed to occult or mysterious agencies and the results seemed to lack a reasonable explanation.

It is only during the past few years that any reasonable scientific concept of the mysteries of hardening metals has been available. In this connection the development of the "slip interference theory" by Jeffries and Archer in 1921, based upon a broad search and analysis of factual material then available, laid the foundation for great and rapid progress. While all the problems of hardening phenomena have not yet been fully explained, we now have an understandable picture involving the qualities of crystalline structure, allotropy of iron, grain size, solubility, diffusion, nucleation, keying particles and the effects of distorted or strained space lattices.

An outstanding step in the evolution of heat treatment from an art to a science was the announcement by Bain and Davenport in 1930 of the so-called S-curve phenomena, or the T-T-T curve.

All of this modern work in turn was possible only through the investigation of preceding scientists. Gore publicly announced "Recalescence" in 1869, and, by 1880 it was recognized that there was more than one allotropic modification of iron. The loss of magnetism in iron at red heat was observed 300 years ago.

In 1899 Roberts-Austen published the first iron-carbon diagram, which was re-published by Bakhius-Rooseboom in 1900, applying the phase law of Gibbs.

Heat Resisting Alloys

The development of modern turbo-jet engine has greatly advanced the production of heat resisting alloys, which must retain their strength at temperatures as high as 1600°F. or more.

Heat Treatment of Cast Iron

In early days it was recognized that allowing iron castings to remain in the yard from six months to a year, in some mysterious way improved their properties. This principle is now recognized as a form of stabilization or stress relief. The old method has been replaced and vastly improved by the application of moderate temperatures over a number of hours, which both relieves residual stresses from castings and helps to make the metal more stable in its behavior.

The heat treatment of castings of special cast irons, such as the Meehanite series, the more recent Ductile Cast Iron of the International Nickel Company, and various forms of steel casting has become very general.

Duralumin—"Age-Hardening"

Early in this century, Dr. A. Wilm, in Germany, worked on several aluminum alloys, and about 1911 brought out one which he copyrighted under the name "Duralumin." This had properties so different from those of hardened steel as to be considered miraculous. The material was heated to a moderate temperature—about 950-975°F. and quenched in water, after which it was soft and ductile, with moderate strength. Allowing to stand at room temperature caused it to harden spontaneously, rapidly for the first few hours and then more slowly for a total of ten days, after which it had a tensile strength comparable to that of ordinary steel. Its specific gravity or weight per cubic inch was only about one-third that of steel. This was the first new light alloy and one of its principal applications was in the construction of the German rigid airships of the Zeppelin type.

The hardening behavior of this material was unexplainable until about 1919 when Dr. Paul D. Merica (now President—International Nickel Company) and two associates at the Bureau of Standards announced the theory of precipitation hardening. Duralumin, consisting of approximately 4.50 per cent copper, 0.5 to 1 per cent each of manganese and magnesium alloyed with aluminum, contains a hard compound, $CuAl_2$, which goes into solid solution at about 950-975°F. Rapid quenching retains this in sub-microscopic dispersion, but it is unstable and tends to precipitate out at room temperature in the form of exceedingly fine particles of hard $CuAl_2$, still submicroscopic. These particles resist slip along the crystalline planes of the matrix, therefore, resisting deformation. This is the equivalent of hardening and strengthening the metal. Warming slightly, or heating to moderate temperatures up to 300-400°F. greatly accelerates the precipitation and, therefore, the hardening action, causing it to take place in a few hours instead of ten days. Too much heating enlarges the key particles until they no longer exert the maximum interference with slip planes and the metal, therefore, becomes softer and weaker. Modern alloys of this type develop a tensile strength as high as 75,000 psi, or more.

Paul Dyer Merica
1889 to ——
Now President of the International Nickel Company, but, when with the U. S. Bureau of Standards, his investigations on Duralumin initiated the present theory known as "precipitation hardening," which has led to a great many useful heat-treated alloys.

An understanding of this phenomena led to the creation of many non-ferrous alloys, particularly beryllium copper, K-Monel and others. It also threw great light upon the phenomena of hardening of steel.

High Speed Steels

One of the earliest developments in the alloying of steels, and one of the most important, was the development in 1868 by Robert Mushet of so-called "self-hardening" steels. Taylor and White further developed this type of steel and first exhibited it at the Paris Exposition in 1900, where a tool was shown cutting metal at a rate so fast that the tool itself became red hot, but retained its hardness. The results were first received with out-spoken incredulity and the exhibit was called a "Yankee fake." High speed steels, however, soon revolutionized the manufacture of metal parts, more particularly in the automotive industry where mass production was paramount. The number of labor hours saved by this material alone is incalculable.

Many forms of high speed steel have been developed during the present century. They have been greatly supplemented, but not replaced, by the invention of cemented tungsten carbide tools, which are made by powder metallurgy and are originally hard, therefore, not susceptible or in need of heat treatment.

Differential Heating

Formerly, ingenious methods were required to create a hard surface or a differential hardness from one part of a piece to another. Pack hardening for this purpose is a very old art. A modern development in this field is that of flame hardening or hardening by electric high frequency induction either of which permits localized heating and quenching of certain areas without affecting the remainder of the piece. A noteworthy example of the application of this principle is in the hardening of the wearing surfaces of crankshafts.

Horace Calvin Knerr,
1888 to ——
Published the first calculations of the strength-weight factors of structural materials (strength-weight factor equals: tensile strength ÷ 1,000 ÷ specific gravity); which has done so much to advance the evolution of heat treating in order to make materials stronger although no heavier, and to improve the design of articles (such as airplanes, certain automobiles, and the like).

Advances Due to Aircraft

Beginning with World War I, 1918 to about 1920, the development of aircraft created a vital demand for lighter materials of construction. The Duralumins in their various forms were widely used, but had some limitations as to corrosion, fatigue, and detailed failure. The development of heat treated alloy steel for landing gear, wing spars and other vital parts was greatly stimulated. During World War II the scarcity of alloying elements in a steel sometimes gave a better result than an equal total proportion of a single one.

The idea that the weight of a structural part depends upon two factors, namely, strength and specific gravity was appreciated in early aircraft engineering. Horace C. Knerr, then Chief Metallurgist of the Naval Aircraft Factory, published what may be the first discussion of "Strength-Weight Factors" in Automotive Industries magazine April 19, 1923. Although steels have a higher specific gravity than aluminum alloys—about 3 to 1—they are also about three times as strong per square inch of cross-section, therefore, the strength-weight factor of high tensile alloys steels is about equal to that of heat treated aluminum alloy. The same is true for magnesium alloys. Accordingly, they are all about equally "light" as materials of construction. Choice between them then depends upon other qualifications such as convenience of fabrication, availability, resistance to fatigue, corrosion, the ability to weld, etc.

Controlled Atmospheres

Edwin Fitch Northrup
1866 to 1940
He first conceived the idea of localized heat treatment by localized heating (in his case, by induction electric furnaces), instead of differential chemical anlysis (as by carbonizing or nitriding).

The idea is old of packing the metal in some harmless material such as cast iron borings, spent carburizer, or of heating it in a molten salt bath, and even of surrounding it in a heating chamber or retort with a special gas. From 1850 onward many patents were granted for all these purposes and the use of carburetted hydrogen, coal gas, carbon monoxide, waste flue gases and the like was experimental but hardly commercial until the advent of electric furnaces simplified the problem. This happened about 1920 to 1925. Now, improvements in other types of furnaces and of suitable heat resisting metals for retorts permitting the use of fuel, has greatly advanced the use of special atmospheres. The generation of these atmospheres has been accompanied by a new technique and new equipment for many forms. Bright annealing of copper has long been accomplished in steam, but the deleterious effect of either steam or carbon dioxide on steel at high temperatures was known early. Special atmospheres for steel treating furnaces are generated from charcoal, partial combustion of illuminating gases, natural gas, propane, the dissociation of ammonia and so forth, all with or without special methods for removing water vapor. This is distinctly a development in research of the Twentieth Century. It has gone a long way toward eliminating the nuisance of scale, surface oxidation and de-carburization.

Conclusion

It can safely be said, without fear of contradiction, that the first half of the Twentieth century has seen a substantial series of truly vital developments in the field of the heat treatment of metals: developments which have affected not only the lives of countless individuals but the economies and strengths of nations.

The Effect of Structure on Machining Characteristics of Steel

By V. H. Erickson, *Chief Metallurgist*
American Steel Treating Co.
Crystal Lake, Ill.

Many tests have been, are, and will be made in an attempt to establish facts concerning structure versus machinability as it is related to automatic screw machine operation. However, unless a set of standards is used so that a common denominator can be established, many will be meaningless.

In machining of metals, the metal being cut, the cutting tool, the cutting fluid or coolant, the process and type of machining tool and the cutting conditions all influence the results. By changing any one of these factors, different results will be obtained. It seems impossible to have a set of conditions which will satisfy all phases equally. It is imperative, therefore, to adjust to a combination for the most effective compromise.

Machinability is a term used to indicate the relative ease or satisfaction with which a material is machined by sharp cutting tools in operations such as turning, drilling, milling, broaching, threading, reaming, sawing or grinding. Values of machinability are usually comparative and represent the behavior of the material under a given set of conditions.

Factors of importance are:

1. Cutting speed
2. Tool life
3. Power consumption or cutting force
4. Finish
5. Accuracy of dimensions

Many types of tests have been developed for indicating the machinability of a given metal.

1. If the machinability is to apply to the tools, materials should be constant.
2. If the machinability is to apply to material the tools should be constant.
3. If the cutting fluids are introduced as a variable, then the tools and material should be constant.

Factors affecting machinability

1. Material being cut
   (a) Analysis
   (b) Structure
   (c) Shape
   (d) Size
2. Cutting speed
   (a) Size
   (b) Shape of cut
3. Cutting tool
   (a) Its material
   (b) Quality
   (c) Treatment
   (d) Shape
   (e) Size and condition
4. The condition of the machine on which the cutting is done, together with the process involved.
5. The cutting process—a given material may have different ratings for different processes, as turning, drilling, milling and grinding.
6. Factors involving rigidity of the tool and work holding device.
7. The characteristics of the cutting fluid used.

Therefore, the optimum or best cutting condition involves the material being cut, the tool, the mechanical device, and the cutting fluid. For any given material there is a certain balance of variables that will give the best results. When a substitution is made it invariably calls for a readjustment of one or more of the variables. The present state in the art of cutting metals leaves the selection of various factors for a given problem to be determined largely by the trial and error method.

Chip Formations—Chips of ductile metals are removed invariably by plastic flow. There are two general forms, the ribbon or elementary form and the sectional form. The elementary type is continuous and practically of uniform cross sectional area, but made up of very thin transverse slip bands or elements. In the sectional type, the small elements are grouped into clusters or sections of approximately the same size. Many times these sections cling together to make a long continuous chip, but the outer edge is always saw-toothed.

Almost immediately after starting a cut, a small particle of material being cut will be trapped on the face of the cutting tool and forms what is commonly known as a built up edge. The built up edge is a function of analysis and structure of the material being cut, influenced to some extent by the rake of the tool, speed, size of cut and the cutting fluid.

Equations regarding cutting speed and tool life relations, forms, energy and power relations, power torque and thrust, can be picked up from most any handbook, and are important if making actual tests. They will not be discussed further at present.

Most people in the ferrous cutting field today order their steel to be annealed to a definite range of hardness. They have arrived at this hardness range by observing the cutting qualities over a period of time. Many years ago we observed that even in the set range of hardness some steels machined well, giving a good finish, and some did not. This led to intensive microscopic study to determine why. We were well aware of the fact that after a heat of steel had been hot rolled and annealed, the hardness of the cold drawn product could be controlled to some degree by the amount of cold work applied to it. Therefore, material from the same anneal if given varied amounts of cold work could show a wide range of hardness. It seemed logical, therefore, to work to a definite structure rather than a close hardness range.

Steel, as is well known, is not a simple homogeneous mass. It is a complex combination of metallic elements and non-metallic inclusions. The non-metallic inclusions are there by design or by accident. Some are placed in steel to aid machining, some are residuals of scrap and slag. The arrangement of the elements can be controlled by heat treatment, so it resolves

down to a determination of which arrangement best suits the machining operations.

Annealed steel will produce structures that will fall basically into two classifications, lamellar pearlitic, and spheroidized. There are many variations and combinations of these structures. Their form is just what the names imply. Lamellar pearlite is a structure that has a laminated appearance, and spheroidized is an arrangement of little globules or spheres. The two, or combinations of them are the structures that are encountered in the majority of machining operations.

The density of the carbon, cementite or carbide constituent in steel is directly responsible to the amount of carbon and alloy in the analysis. The free ferrite or iron that makes up the balance, while influenced to some extent by non-metallics and alloys, is soft and ductile. The carbide constituent is hard and brittle. It is reasonable to believe that as a cutting tool works into the metal, the soft ductile ferrite would be pushed ahead of the tool until it comes to a band or lamination of the harder material. The hard brittle material would crack and break ahead of the tool and would tend to clear the gummy ductile mass being pushed. You will remember ductile metals are cut and chips formed by plastic flow.

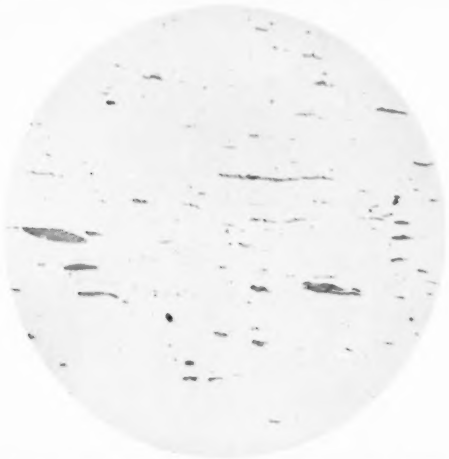


Fig. 1—Bessemer Screw Stock. Showing Manganese Inclusions.

Let us consider lamellar pearlite. It consists of thin plates or lamellae of the carbide constituent interlaid with free ferrite. The pattern formed may be in many variations and have a definite influence on the machinability. If the lamellae are close and and the free ferrite well distributed, the material should be ideal. If the free ferrite is unevenly distributed, it has a tendency to foul the tool, create drag and generate heat. The built up edge will increase. It would be similar to cutting through wax with an ordinary case knife. The wax fouls the knife and does not tend to cut clean. Place any material that has some hardness or brittleness in layers, that is a layer of wax and then a layer of the harder material and immediately one can cut through with less fouling. Lamellar pearlite structure is ideal for good machining on automatic screw machines in almost all steels with the carbon content below .50. When the carbon goes above that point, we have too much carbide constituent to overcome, and it is then that tool life is greatly impaired. It is evident then that an adjustment of the arrangement should be made to counteract this. That is where spheroidization comes into the picture.

Fig. 3—Lamellar pearlite. Alternating plates of ferrite and cementite.

A spheroidized structure is just as easy to attain as lamellar pearlite. Under the microscope, it looks like small globules of carbide distributed throughout the ferrite. In steels with less than .50 carbon in the analysis, there is again more free ferrite than carbide. Thus the tool will be passing through gummy material. The spheroids having tough boundaries tend to push to one side or ahead of the tool rather than break up. This does not clear the tool. Consequently, there is greater drag and built up edge. Heat is generated rapidly, and tools have a tendency to burn. As the carbide constituent is increased the globules become greater in number. When we approach the .50 carbon in the analysis, the globules are present to the extent that they cannot be pushed aside, but must break ahead of the tool. Again we have the tool passing from gummy to hard material alternately, and the clearing action again takes place.

There are usually exceptions to all rules. In steel we find this true also. On machines that operate at high

(Continued on page 23)

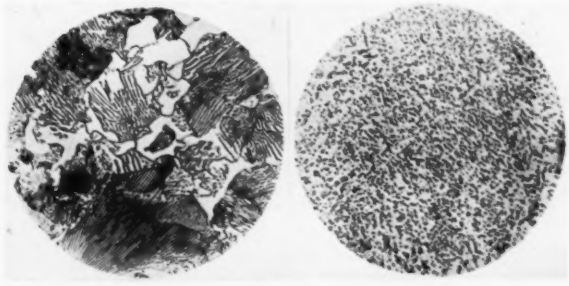


Fig. 2

Lamellar pearlite anneal. Cold drawn. **Spheroidize anneal. Cold drawn.**

Hardness is not necessarily a criterion of machining quality. The spheroidized steel of same hardness as the pearlitic steel was so inferior in machinability it could not be run on a production basis.

The Application of Ratio Delay Principals to Heat Treating Operations

By Chas. R. Weir
Commonwealth Industries, Inc., Detroit, Mich.

Some months ago Commonwealth Industries, Inc. of Detroit engaged the firm of R. A. Schettler & Associates to make a survey of our plant operations. A most interesting and instructive part of that survey is outlined briefly below. In our opinion, it represents a rather unique approach to the commercial heat treaters' old problem of utilization of manpower and equipment. Such problems are typical in all jobbing businesses, especially where relatively large equipment and installations costing many thousands of dollars, demand full economic use. The conventional time study techniques were considered too costly and cumbersome in view of the wide number of variables present.

What we wanted to know was: of the available time, how much was actually productive from the standpoint of both equipment and operator? We also hoped to learn what part of the available time was spent on maintenance, down time, etc.

It was decided to apply the ratio delay, or work sampling technique, to the problems. This procedure consists of making observations, at random intervals, of a department or, in this case, a group of furnaces. At the time of observation it is noted whether the furnaces and/or operator is in a productive or delay state. The productive percentage is the ratio of the number of productive readings to the total number of readings. The delay percentage is the ratio of the number of delay readings to the total number of readings. An obvious advantage of this technique is its simplicity, requiring little training and relatively little observer time.

To obtain a representative sample, observations should be taken at random times throughout the work day and during different working days.

Productive and delay states must be clearly defined and the decision of which state exists must be made instantly—delays should not be anticipated.

Care must be taken to avoid making periodic stops, which may coincide with the clock, as this may result in the recording of the same cyclical delay on each round.

Long delays should be recorded only once, as the ratio delay theory is based on the percentage number of delays rather than their length. If sufficient readings are taken, the relationship holds whether the delays are long or short.

For purposes of our survey, we subdivided the plant into five homogeneous groups, but this article will concern itself with the atmosphere furnace group only.

Table #1 is a copy of one of the daily work sheets. On the day shown, eight observations were made on each of the furnaces and operators in the group, and the numbers appearing under the various column heads indicate the time at which the observation was made. Each individual time posted represents one separate reading. Thus, the reading taken at 7:50 on furnace number 8 shows it to be producing or turning out work (these are all continuous furnaces). The 7:50 reading taken of the operator shows him to have been idle. It is to be noted that if the operator were engaged in any activity in connection with his work, such as reading instruments, writing report, preparing stock, etc., he was noted as producing. It should also be noted that his absence from his job is not necessarily assumed as idle time, as he may have been checking on his next job, consulting with his foreman, or merely gone to the washroom. The readings from this daily summary sheets are posted to an accumulative summary which is used to plot overall results.

These results, as seen from the graphs (next page), demonstrate rather clearly the actual utilization of men and equipment. Obviously, the more readings taken, the more accurate the results become, since the accumulative readings line will ultimately become a straight line. The accuracy of this method is within limits sufficiently narrow to serve as an excellent guide for future planning and action. A statement of conclusions then would be drawn from the following data on the furnaces:

TOTAL READINGS TAKEN	652	%
TOTAL PRODUCTION READINGS	559	85.7
TOTAL SOAK READINGS	47	7.2
TOTAL REPAIR READINGS	18	2.8
TOTAL "NOTHING SCHEDULED" READINGS	22	3.4
TOTAL "CLEAN UP" READINGS	2	.3
TOTAL "HEAT CHANGE" READINGS	4	.6
TOTALS	652	100

The data shows that the furnaces were actually producing 85.7% of the time with soak and heat change readings accounting for another 7.5%. These figures, combined, indicate that the furnaces were being utilized 93.2% of the available time, which we considered

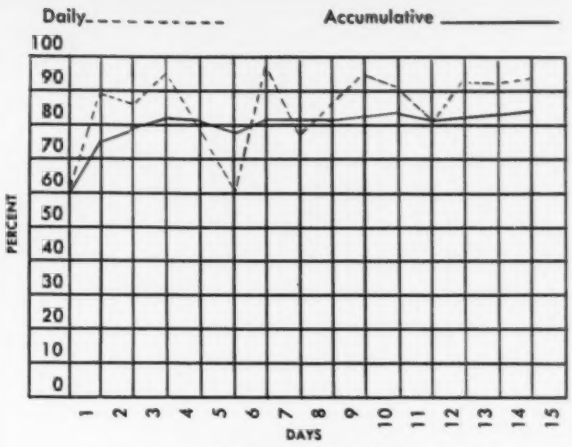
very good—possibly more capacity was indicated.

The data, shown in the next column, on the operators of the equipment gives a far different story. One point should be noted in this regard, however; the figures are "average" figures for all the furnaces. The furnaces are by no means identical either in output or the labor required to produce.

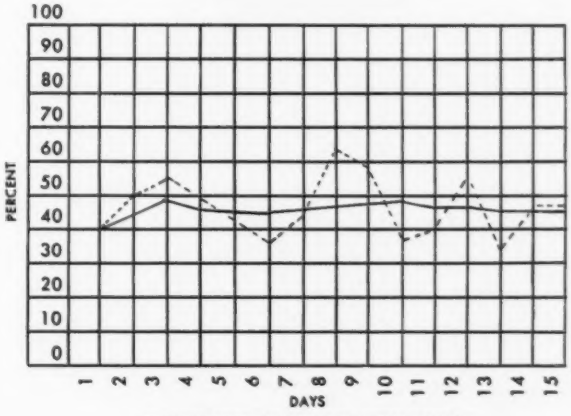
TABLE #1 — ATMOSPHERE FURNACES — SUMMARY

FURNACE							OPERATOR			
Furnace No.	Productive	Soak	Maint. & Repair	Nothing Scheduled	Clean Up	Build Up Heat		Productive	Idle	Absent
1	1055 1135 105	715				1005	Oper.	1055 1055 105	1135 155	
							Help.	1005 1135 105	1005 155	
2	715 750 955 1005 1055 1135 105 155						Oper.	715 755 1135	955 1005 1055 105 155	
3				715			Oper.			
5	750 715 955 1005 1055 1135 105 155						Oper.	750 955 1005	1055 1135 155 715	105
6	715 750 955 1005 1005 1135 105 155						Oper.	715 955	715 1005 1035 1135 105 155	
7 6	715 750 955 1005 1055 1135 105 155						Oper.	1135	155	750 715 1005 1035 955 105
8	715 750 955 1005 1055 1135 105 155						Oper.	1135	715 955 1005 105	750 1055 155

CHARTED PRODUCTION READINGS



ATMOSPHERE FURNACES



ATMOSPHERE FURNACE OPERATORS

TOTAL READINGS TAKEN	730	%
TOTAL PRODUCTIVE READINGS	337	46.2
TOTAL IDLE READINGS	310	42.5
TOTAL ABSENT READINGS	83	11.3
TOTALS	730	100

The conclusions lend support to an idea already held by the supervision. That is that, except in rare instances, no helper is necessary on any of the furnaces. On all of the furnaces which are automatically loaded (four), the operator is productive less than 40% of the time. The survey shows that this group of atmosphere furnaces requires only five operators instead of the present eight.

It is clear that solutions to the problems posed in the above will be as different as are the various plants and organizations in the industry. It is true that the existence of the problem must be known before a solution can be developed. To that end, we believe, this type of study to be a worth while management tool.

Heat Treatment of Magnetic Materials*

By R. E. Wolf
Minneapolis-Honeywell Regulator Co.
Minneapolis, Minnesota

This is not going to be a technical paper. I merely wish to pass on the message to the commercial heat treaters in regard to the heat treatment of nickel iron alloys such as Westinghouse hypernic, Carpenter 49 and Armco 48 for magnetic properties. The other constitutents in these alloys are chromium, molybdenum, copper and iron.

These alloys are used mainly in supersonic equipment, shields against magnetic fields, relays and solenoids, transformers, motors and generators.

The application of these magnetic materials in industry has increased to a point where the alloys are no longer considered rare. Their presence in our raw stock has made it necessary for us at Minneapolis-Honeywell to learn to fabricate these alloys, using research controls on a production basis. In this we have been assisted a great deal by a commercial heat treatment plant in Minneapolis, Metallurgical Control Laboratory. They at the present time are doing all of our magnetic annealing in the Minneapolis area.

I may mention here that when we got into trouble about a year ago, Drever Company here in Philadelphia helped us a great deal. Magnetic Metals over in Camden helped us out quite a bit.

In the past, the annealing of nickel iron alloys has been shrouded in mystery and commercial heat treaters as a whole have been kept in the dark as to the process for annealing this material. There is no reason, however, that commercial heat treaters should not be doing this type of annealing. The need for this type of magnetic material is growing in industry, so the need for competent heat treaters for annealing this material also grows.

This material is being used in our defense program to a great extent, especially in companies like our own where we are making controls for airplanes that have to be very sensitive and react very quickly.

The equipment required for this annealing is very simple: an airtight furnace capable of holding temperatures from 2050 degrees Fahrenheit to 2200 degrees Fahrenheit, depending on which type of material you have to anneal. You have to have boxes or canisters made out of a high nickel alloy, such as Inconel or Incaloy; either one is acceptable. If you wish to use expendable materials, you can use any of your other steels, but they won't stand up under this terrific heat. A deoxo drier for drying out your hydrogen and a standard dew point indicator is about all that is necessary for doing this type of annealing.

All mechanical operations on these nickel alloys, such as the rolling, forging, bending, forming and machining, create definite strains in the material and reduce magnetic properties a great deal.

In using these metals it must be kept in mind that any mechanical working and straining are harmful to magnetic properties. To fully restore these qualities, the nickel iron alloys must be annealed after mechanical working. Reduction of histeresis losses and improvement of permeability are realized after this electrical anneal.

There are a few general rules and precautions necessary to commercially anneal magnetic parts for uniform magnetic and physical properties. First of all, your material has to be clean. It would require a vapor degrease or similar method to remove all the dirt and accumulations that may be on the material. Then where you are using the stamped laminations, when it goes through this heat it has a tendency to stick together, so you have to powder it with alumina powder of 400 mesh or finer and spread it in between the layers so it will not stick. In general we string our laminations, but they can also be stacked just so you have this alumina powder in between them.

Oxidation we all know would be very injurious to the magnetic properties and it produces brittleness; therefore, the parts have to be annealed in these canisters and boxes, sealed, so that you can introduce an atmosphere of pure hydrogen free of all traces of oxygen. A constant check on the dew point must be kept to maintain a dew point of minus 60 or under. These boxes or canisters must be pressure tested before being put into the furnace by seeing that they are absolutely airtight and there is no possibility of oxygen entering the parts you are annealing.

Your heat cycle should be arranged so that all parts of the load are at a temperature of 2200 degrees Fahrenheit for approximately two hours, followed by a slow cooling at 100 degrees Fahrenheit per hour until the furnace is down to approximately 1000 degrees. After that, you can take the box or canister and remove it from the furnace. However, the flow of hydrogen must be kept until the box containing your parts has cooled to room temperature.

Great care must be taken after the anneal that the heat treater doesn't accidentally drop the box or canister containing the parts, because if you drop them, even a drop of eight to ten inches, we have found it destroys the permeability that you have acquired through the anneal that you have just given the parts.

The quality of the anneal is evaluated by checking the magnetic properties of the material, such as permeability and hysteresis loss. Our great trouble in Minneapolis-Honeywell is that we haven't had anybody outside of Drever Company and Magnetic Metals who were set up to do this type of anneal for us. We have to go out and try to find somebody in the local area to do it so we wouldn't have to send our material up here.

I might mention that Drever did such a good job for us that we bought one of their furnaces.

The main use of this material, as I said before, will be found in the instrument companies who are making delicate instruments and it will need the help of all the heat treaters throughout the country to be able to set up for this type of anneal to keep the war effort up to a point where it should be.

* Presented at the annual meeting of the Metal Treating Institute, Oct. 17-19, 1952.

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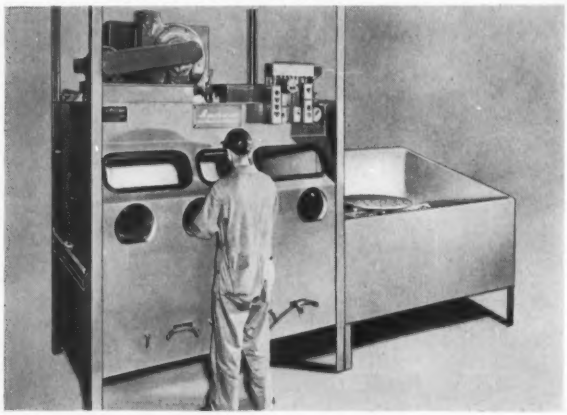
News to Heat Treaters...

New Model Wet Blasting Machine

A new model wet blasting machine is announced by American Wheelabator & Equipment Corp., Mishawaka, Ind.

Known as Model 64 Liquamatte, it is intended for all precision cleaning and finishing applications involving large and heavy pieces. Some typical applications are in the manufacture and maintenance of forging dies, die-casting dies, drawing dies, glass, plastic, and rubber molds; the reconditioning of plant engines, oil burners, etc.; cleaning jet engines after shakedown tests; surfacing tools, before and after plating; blending different types of finishes on aluminum; removing heat treat scale, and de-burring.



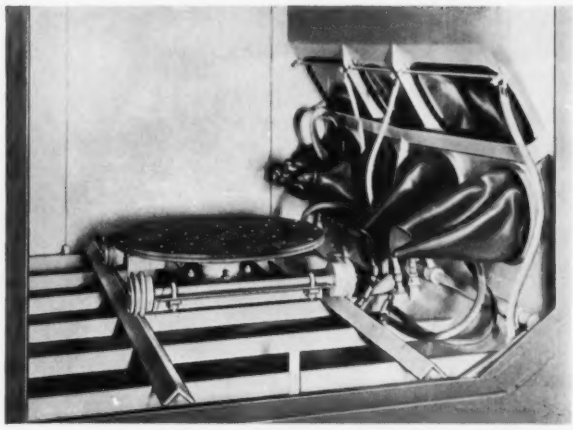
New Model 64 Liquamatte wet blasting machine.

Size 6 ft. in length by 6 ft. 10½ inches in depth by 8 ft. 11 inches in height. Will handle single pieces or loads of pieces up to 3500 lbs. in weight. Has two 49" x 36" counter-balanced doors and a 6 ft. long accessory tank to receive the parts from the blast chamber for rinsing.

Fine mesh abrasives, suspended in water, are propelled at the work by compressed air, but since such fine mesh abrasives are used (80 to 2500 mesh), close-tolerance dimensions are maintained, and sharp corners, lines and lettering in patterns, flat surfaces, knurling, thin-walled sections, and other normally vulnerable areas remain undamaged and unaltered.

Model 64 Liquamatte has two sets of armholes so that two operators can be accommodated at once, if necessary. Otherwise, one operator can occupy any one of three positions. There are three abrasive nozzles, individually controlled, ready for use at any time. Different sized jets in each nozzle makes for optimum versatility.

The operator stands outside the cabinet, with his arms extended through gauntlets, and manipulates the abrasive gun and the work table with his hands while operating the compressed air valve with his knee. When blasting is finished, he rolls the work car out onto the power rinse tank (tracks run the entire



Interior of new Model 64 Liquamatte wet blasting machine.

length of the blasting compartment and rinse tank) where the work is rinsed with water raised by a pump through a hose. Ferrous parts are rinsed in inhibited water. Immersion heater units are available for the water, so that parts dry faster and there is less chance for oxidation.

Among the special features of this machine are push button controls, located on one central control panel. To start the Liquamatte, the operator turns on light and pushes two starting buttons. No valves to open or close.

Another feature is the vertical pump for slurry agitation and recirculation. It is adaptable to rugged service, and because of its position, it eliminates all suction piping, valves, fittings, and labor for removing them for inspection of the pump. It is always primed by flooded-type suction. Loss of slurry through leakage is eliminated, because there are no packing glands. Abrasive can't plug the pump impeller when the machine is shut down. Another important feature is that the hopper need not be drained before the pump is removed.

The machine has a conveniently low work-ceiling, but the bottom of the machine is high enough off the floor to make good housekeeping possible. Rubber hose has been used instead of metal pipe wherever possible. Not only is this an advantage from a maintenance standpoint, but it eliminates noise from water hammer.

The armholes are equipped with gauntlets so that every workman can use his own gloves. Gauntlet drainage has been carefully designed so that there will be no slurry dripping down the front of the cabinet. Small parts to be cleaned, can be passed through armholes without opening doors.

An Abrasostat is available which tells at a glance the number of blasting hours that the abrasive has been in the machine. It lets the operator know when to change abrasive and makes it easier for him to avoid wasting abrasive. When the abrasive does need

changing, the operator doesn't need to bale out slurry or handle it in any way. An air ejector is available for blowing the slurry through a length of hose either to a sump pit or to barrels.

A clear view is available through any of the vision windows, and cool fluorescent lights do not cause abrasive to bake on the illumination windows, thereby cutting out illumination. The work car has grooved wheels which ride on inverted "V" tracks. This eliminates any possibility for abrasive build-up to hinder car movement. Wheels are equipped with anti-friction ball bearings and are designed for operation in the presence of abrasive slurry.

Lindberg Goes West

Cary H. Stevenson

Lindberg Engineering Company, 2450 W. Hubbard Street, Chicago 12, Ill., manufacturers of industrial heat treating furnaces and supplies, has purchased 4½ acres of land adjoining the Southern Pacific Railroad tracks in Los Angeles, California.

The company plans the building of a plant and offices for the manufacture of all types of Lindberg Heat Treating and Lindberg-Fisher Melting Furnaces as soon as possible.

Complete manufacturing equipment will include a railroad siding and cranes for loading and unloading of heavy units.

In making the announcement of the new Lindberg Los Angeles plant Cary H. Stevenson, Vice President, said: "We have great expectation in the added production facilities in this area of rapid industrial expansion on the West Coast.

"The new plant will enable us to provide better service to our customers on the coast, help speed up our defense orders to the aircraft industry and give us the necessary capacity for new projects and the production of our high frequency equipment, low frequency melting and radiant tube furnaces."

Lindberg Engineering Company of Chicago, Ill., is one of the leading suppliers of industrial furnaces to the aircraft industry and has already supported the defense effort of this industry on the West Coast with more than 900 furnaces.

"Catalyst" for Carbon Determination

A specially prepared, finely divided iron powder is now available for use as a combustion accelerator in metal analysis. Its name, Combax Accelerator, is derived from Fisher Combax Combustion Boats, already widely used and is manufactured by the Fisher Scientific Company, Pittsburgh, Pennsylvania.

A common control used in the manufacture of steel is carbon determination in which the Fisher Induction Carbon Apparatus has replaced other, less practical methods. Combax Accelerator is added to the sample to be ignited in the Induction Apparatus when the sample is non-magnetic—difficult to fire by induction heating.

Combax Accelerator is prepared by a hydrogen reduction process which frees it from carbon and sulfur impurities.

It has an extremely low carbon content (less than a point, or 0.01%, of carbon per factor weight of 2.727 grams), and negligible traces of sulfur (not more than 0.0025%). Particle size is 50 mesh, most efficient for induction heating.

This new product will be of interest to chemists and metallurgists who have converted from the old system of burning samples in conventional tube furnaces to the modern Induction Carbon Apparatus. The latter makes use of an integrated train which, when used with the automatic Gram-atic Balance, has produced complete, accurate carbon determinations, according to laboratory reports, in *150 seconds*.

Magnet Kits Available

A "You-Try-It" kit of permanent magnets is available to enable industrial planners to devise their own new uses for permanent magnets within their own plants.

The kit is being marketed by the Carboloy Department of General Electric Co., Detroit 32, Michigan.

Carboloy permanent magnets have already found a wide use in such various applications as recovering tools from liquid tanks, feeding sheet metals into presses, holding steel plates for painting, affixing models on plant layouts, and picking metallic waste from conveyor lines.

Carboloy has designed the "You-Try-It" kits because it believes that countless additional uses for

Carboloy "You-Try-It" magnet kits designed to enable industrial planners to devise their own uses for small alnico magnets.

permanent magnets can be found when engineers have the magnets at their disposal for their own experimental purposes.

Two kits are available. Shop package number one contains 48 Carboloy permanent magnets in eight styles. These magnets have up to two pounds of "pull" for each unit. Shop package number two contains 18 larger magnets, in four different styles. These have a "pull" of from three to 12 pounds. Shop package number one sells for $10, number two for $15.

This is the first time that an assortment package of small size magnets has been made available.

Descriptive literature regarding the kit is available from Carboloy.

(Continued on page 16)

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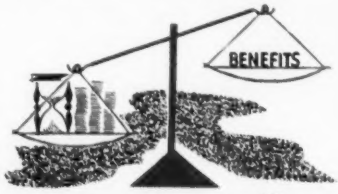
First of all, it is likely that there is a commercial plant located near you that will not only have the facilities and equipment, but the skill and experience to perform the heat treating operations required, whatever they may be.

Secondly, the establishment of a new department or the expansion of your present one would require an inordinate amount of time and investment; — out of proportion to the benefits which might result.



Thirdly, the new plant or department or equipment will, when the need for it no longer exists, only stand idle or be scrapped. This was proved painfully in the recent post-war years.

Finally, even if only government money is involved, remember this is *your* money and the economical handling of it will be to your benefit.

If you are faced with heat treating problems or the need for heat treating services, write

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or consult the MTI members listed on the following page.

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Dexter Metal Treating Co.
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Industrial Steel Treating Co.
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Commercial Metal Treating, Inc.
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Ferrotherm Company
4911 Butler St., Pittsburgh
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11

WISCONSIN

Wesley Heat Treating Co.
825 South 21st St., Manitowoc
Hushek Metal Processing Co.
1536 West Pierce St., Milwaukee
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1745 Taylor Ave., Racine
Spindler Metal Processing Co.
2338 Mead St., Racine
Wesley Metal Treating Co.
2320 Mead St., Racine

Carbon Restoration of Screw Stock

One of the world's largest manufacturers of cap screws and bolts restores surface carbon on screw stock during controlled atmosphere hardening in a Surface Combustion cast alloy belt furnace. The easily controllable atmosphere is produced in an RX prepared atmosphere generator.

Furnace atmosphere carbon potential is controlled

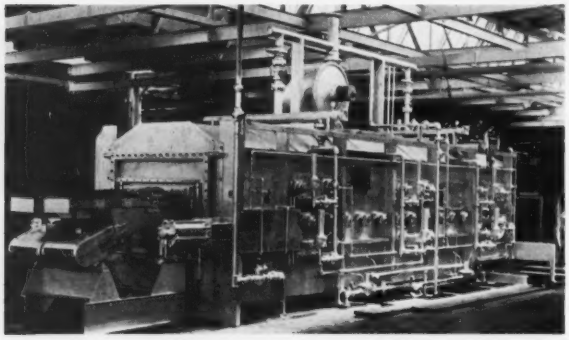


Fig. 1—Radiant tube belt furnace for carbon restoration.

by regulation of dew point, at the generator, to match analysis of steel being treated. Carbon on 0.35 carbon steel stock depleted to depths of 0.006 to 0.007 inches, has been uniformly restored.

Since screws and bolts (Figure 2) hardened in this atmosphere are free of decarburization (Figure 3), they can be threaded by economical rolling instead of machining.

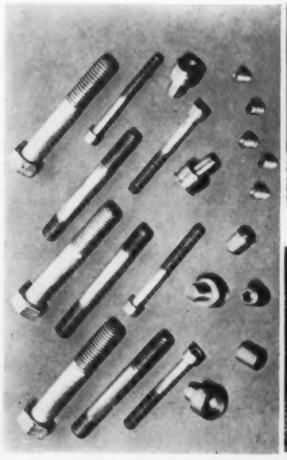


Fig. 2—Some bolts and fasteners treated in this furnace.

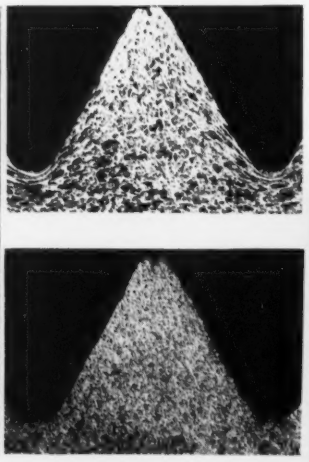


Fig. 3—Micrographs reveal uniform restoration of carbon in threads.

New York Firm Cuts Hardening Costs 48 Per Cent

A 48 per cent reduction in the cost of hardening basket shafts for use in washing machines has resulted through the use of two General Electric 15-kw electronic induction heaters at the Syracuse, N. Y., plant of the Easy Washing Machine Company.

According to Victor Barden, general foreman of Easy's Heat-treat Department, the entire cost of the hardening process, including labor, power costs, repairs, depreciation, and overhead, has been reduced from 13 cents to 6¾ cents per basket shaft by the installation of the G-E heaters.

Before adopting the induction heater method, the firm hardened the shafts with a cyanide process, Mr. Barden said. In addition to the cost of the chemicals, this process took three shifts of two men to harden 1600 shafts. Now, with the G-E heaters, one man is able to accomplish the same thing in one eight-hour shift. This has allowed the company to transfer five valuable men to other, more productive posts.

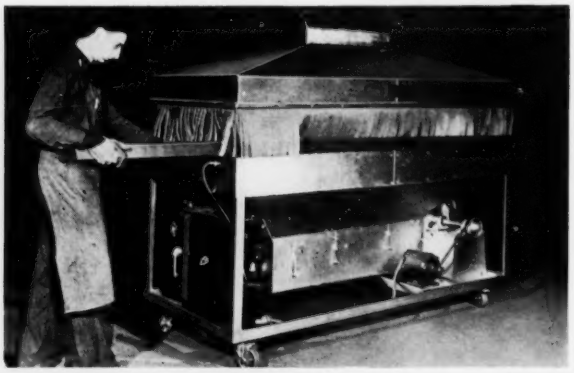
The company also reports better hardness characteristics than were generally achieved under the old process. The equipment allows exact and automatically controlled heating and quenching times resulting in a uniform hardness, he said.

Similar savings, Mr. Barden said, have been realized in the manufacture of worm shafts, agitator shafts, and several other components in which the induction heaters are being used. The heaters also supply selective heating for soldering, brazing, and annealing in the firm's highly-developed Heat-treat Department.

Special Aluminum Bar Heating Furnace

To fulfill the needs of the aircraft industry to heat special aluminum bars to approximately 300° F., prior to forming operations, the Pereny Equipment Company of Columbus, Ohio, has just introduced a new portable type electric furnace suitable for the work. The heat treating operation is required because of the special composition of the aluminum. If forming operations are performed prior to this heat treatment, the bars have a tendency to crack when bent.

This new unit, having an oven size of 3 ft. wide by 6 ft. long by 8 inches high, is equipped with a blower to produce proper recirculation of the heated air. A semi-closed opening for feeding and discharging the long bars is provided by means of an asbestos strip curtain. The unit is mounted on rollers so that it can be transported to the immediate location of the following forming operation.

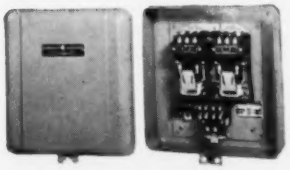


Overall size of the unit is 74 inches high by 72 inches wide by 36 inches deep. Controls include temperature indicator and controller, instrument transformer, magnetic contactor, switch box and motor

starter. Power requirements are 36 kw, 440 volts, 3 phase. Heating elements are of the fin type strip heaters.

This is typical of the line of standard and special units in temperature ranges from 300° F. to 5000° F. that the Pereny Equipment Company, Columbus, Ohio, manufactures.

Automatic Throwover Panel



A new automatic throwover panel, a control device that transfers electric circuits to an emergency power source when the normal source fails, has been announced by the G.E.'s Control Department, Schenectady, N. Y.

For use in hospitals, factories, and all places of public assembly, the new panel automatically transfers emergency lighting circuits, signal or communication systems, exit markers, regulating and metering equipment, fire protection apparatus, etc., to a standby power source when the regular supply is interrupted.

The new G-E panel consists of mechanically interlocked normal-source and emergency-source contactors, and a pilot contactor. Besides transferring circuits from a failed normal source to an emergency source and back again upon resumption of regular service, these contactors also control standby power equipment, such as an auxiliary generator, turning it on and off at the approapriate times.

A special annealing of the entire magnet structure further reduces residual magnetism resulting in consistent drop-out voltages and quick transfer of the load to the emergency source.

The load contactors feature a coil that is completely impregnated in a solid block of solventless varnish for maximum protection against moisture and mechanical damage.

For special applications requiring close control of transfer voltage, as on power lines of poor regulation, a voltage-sensitive relay can be provided to transfer the load at a very closely controlled voltage point. Also, in applications where momentary voltage interruptions are sometimes encountered, as from lightning surges, a time-delay relay can be used to prevent the transfer until after a specified time has elapsed.

The standard line of automatic throwover panels, size 1 to 3, employ vertical-lift contactors, and sizes 4 to 6 use clapper-type contactors.

High Frequency Induction Heating Units

Lindberg Engineering Company, 2450 W. Hubbard St., Chicago 12, Ill., has added a new 50 KW unit to the line of *High Frequency Induction Heating Units.*

The model LI-50A-1 is being built to provide more than 50 KW at 400,000 cycles per second on a 100% duty cycle.

Lindberg Induction Heating Units are recommended for heating and fabricating operations which call for production brazing, soldering, hardening, forging or shrink fitting at reduced cost and floor space requirements.

Specifications: Output—50 KW—2840 BTU per minute, 400,000 cycles per second (approx.) *Input*—230, 460, 550 volts, 3 phase, 60 cycle. 100 KVA (max.)

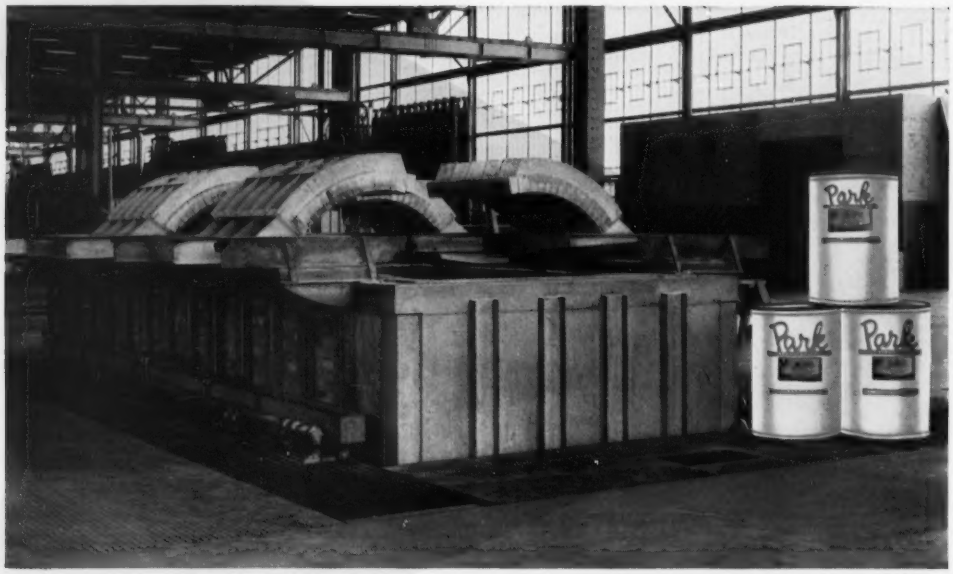
90% power factor. 3 KVA (idling). *Water*—Consumption determined by use. Average at full load 22.5 G.P.M. Pressure 20-80 lbs. *Dimensions*—96" wide, 68" deep, 80" high. *Weight*—5400 lbs. without accessories.

The Lindberg 50 KW High Frequency Induction Heating Unit features a built-in closed water system that circulates temperature controlled water to the oscillator tube and tank coils.

The well designed cabinet is constructed of heavy gauge steel to sturdily support and protect all parts of the Lindberg 50 KW unit.

7 Truckloads

TO FILL THE...



Heat Treating Installation at Bohn Aluminum Corp., Plant 24, Adrian, Mich.

...WORLD'S LARGEST NEUTRAL SALT BATH!

Here is the world's largest neutral salt bath operating over 2000°F. It is used for heating steel billets for press forging. It operates at 2350°F. and holds 128,000 lbs. of molten Park Chemical neutral salt. It is 20 feet long, 10 feet deep and 4 feet wide and is an electric furnace of 5,000 Kilowatt capacity.

The salt is kept neutral by Park's patented (U. S. Patent No. 2474680) Neutra-Gas Process, a simple, efficient, economical method of maintaining absolute neutrality in chloride-base salt baths. Suitable for use from 1350°F. to 2500°F. This patented process completely eliminates objectionable oxides simply by periodically passing a harmless gas through the molten salt.

No rectifiers are required . . . sludging is eliminated . . . and no fresh salt additions are needed except to replace drag-out. Further, the process maintains original fluidity of the bath and work leaves as clean as when it entered.

For specific application recommendations on Park's Neutra-Gas Process, consult your nearest Park service representative or write for Park's new Technical Bulletin No. H-1.

Park
CHEMICAL COMPANY
8076 Military Ave., Detroit 4, Mich.

HEAT TREATING HINTS

TEMPERING IN FIXTURES

Very often parts that have been heated and quenched distort beyond the tolerance allowed for final machining or grinding. Fixture quenching, employing a Gleason Quenching Press or a similar apparatus is one way to control distortion. Marquenching or austempering are other heat treat practices very often used to limit warping or distortion during the hardening process.

All of these methods are unquestionably useful and effective in modern production heat treat practice. However, there are many jobs that cannot be solved by any of these techniques. Tempering in fixtures, as illustrated in Figures 1 and 2, has proved a very satisfactory and economical operation.

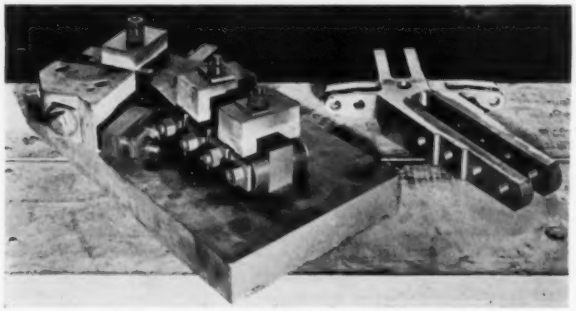


Fig. 1

Alloy steels whose final hardness requirements range from 25 to 50 Rockwell can be heat treated in the conventional manner and tempered in fixtures to very close distortional limits. It is, of course, good practice to temper the as-quenched article at approximately 400°F. and allow to cool to room temperature before clamping into the holding device. The final tempering temperature depends upon the hardness required and the alloy steel used in the manufacture of the part. Processing of parts in this manner has eliminated final machining after heat treating except for the line reaming of the holes. Grinding has been reduced so that only the two short rear lugs on the angular hinge (Fig. 1) need be ground to print tolerance.

Fig. 2

A high strength type of Meehanite casting, stress relieved at 1200°F. for several hours, has proved most satisfactory from a standpoint of dimensional stability and resistance to oxidataion due to repeated use of the fixtures in the final tempering operation. The closer the tolerance of the heat treated part the more often must the fixtures be tested for dimensional accuracy. In the cases illustrated the fixture for the large angular hinge (Fig. 1) is checked for accuracy every eighth tempering cycle. The corrections are very quickly and inexpensively accomplished. In the other example (Fig. 2) the simplicity of the fixture materially reduces the number of times required for testing the stability of the fixture. In both cases the savings in machine and grinding time more than compensate for the additional care and time required for heat treating, checking and tempering.

FRED HEINZELMAN, JR.
Fred Heinzelman & Sons, New York, N. Y.

AVOIDING TROUBLE IN HEAT TREATING TOOLS

It's our guess that more tools are ruined in heat treatment than at any other stage of production. And that's not a criticism of heat treaters. But the heat treatment of tool steel is not usually a simple procedure, especially when so many people try to do heat treating with ancient or inadequate equipment.

There are four steps that will help the heat treater to avoid trouble in hardening: 1—Tools correctly designed; 2—Selection of the right tool steel for the job; 3—Decarburized surface of bar stock should be removed on *all* surfaces; 4—Careful attention should be given to obtaining a smooth surface finish on tools, eliminating tool marks, layout scratches, punch marks, etc.

And, of course, a good heat treater will always observe these standard precautions: 1—On intricate designs or high-alloy grades he will pre-heat before heating to hardening temperature; 2—He will soak tools uniformly at quenching temperature and guard against decarburization . . . 3—followed by effective quenching to 150°F . . . 4—and adequate tempering *immediately* after quenching.

Eight steps in all. And there will seldom be a tool ruined by faulty heat treatment if they're followed.

From Bethlehem Steel Company's "Tool Steel Topics."

Institute News . . .

ANNUAL MEETING

A total of 59 representatives of the members of MTI registered for the 1952 annual meeting which was held in Philadelphia at the Hotel Warwick, October 17 thru 19.

The program placed particular emphasis this year upon important and interesting technical papers which are listed below:

1. Testing as Related to the Heat Treatment of Metals
2. Heat Treatment of Magnetic Materials
3. New Developments in Heat Treating Equipment
4. Contemporary Developments in Alloy Steels
5. Some New Alloy Steels and their Heat Treatment

It was announced that in the past year 12 new members were added to the roster of the Metal Treating Institute and these are listed below:

Acme Steel Treating Co.
Detroit, Michigan

Bosworth Steel Treating Co.
Detroit, Michigan

The Drever Company
Philadelphia, Pennsylvania

Ferrotherm Company
Pittsburgh, Pennsylvania

Hollywood Heat Treating Co.
Los Angeles, California

Lorenz & Son
Philadelphia, Pennsylvania

Metallurgical, Inc.
St. Louis, Missouri

Michigan Steel Processing Co.
Detroit, Michigan

Reliable Metallurgical Service, Inc., Cleveland, Ohio

Senecca Heat Treating Co.
Batavia, Illinois

Standard Steel Treating Co.
Detroit, Michigan

New officers and trustees were elected and these are as follows:

President—A. M. Cox
Pittsburgh Commercial Heat Treating Co.
Pittsburgh 1, Pennsylvania

Vice-President—Clifford Cook
Cook Heat Treating Company of Texas
Houston 11, Texas

Treasurer—Lloyd G. Field (re-elected)
Greenman Steel Treating Company
Worcester 5, Massachusetts

Board of Trustees—Term Expires 1954

Arlo Leidig—Hollywood Heat Treating Co., Los Angeles 38, Calif.
C. H. Muehlemeyer
O. T. Muehlemeyer Heat Treating Co., Rockford, Ill.
Fred. Heinzelman, Sr.
Fred. Heinzelman & Sons, New York 12, N. Y.

Term Expires 1953

C. R. Weir—Commonwealth Industries, Inc., Detroit 8, Mich.
A. Eklund—Eklund Metal Treating, Inc., Lane Park, Ill.
R. G. Sault—Porter Forge & Furnace, Inc., Somerville 43, Mass.

The closing day of the session was devoted to an outdoor buffet luncheon at the plant of the Metlab Company followed by a reception and clambake at the home of the retiring president, J. Walter Rex.

The complete program is given below:

Friday—October 17—9:00 A.M.—Registration—Mezzanine

President's Welcome—Mirror Room

MR. FRANCIS TATNALL, Baldwin-Lima-Hamilton Corp.
"Testing as Related to the Heat Treatment of Metals"

Candid shots of MTI members and wives enjoying Walter Rex's hospitality.

MR. R. E. WOLF, Minneapolis-Honeywell Regulator Co. "Heat Treatment of Magnetic Materials"
Round Table Discussion of Heat Treating Insurance
General Business Meeting

1:00 P.M.—Group Luncheon

2:30 P.M.—MR. V. H. FERGUSON, Ferguson Equipment Corp. "New Developments in Heat Treating Equipment"
MR. M. W. DALRYMPLE, Bethlehem Steel Company. "Contemporary Developments in Alloy Steels"
Committee Reports

6:00 P.M.—Dinner Meeting of the Board of Trustees President's Suite

All Day—Ladies' Sightseeing Tour

Saturday—October 18—9:00 A.M.—Business Meeting—Mirror Room
MR. WM. C. MEARNS, International Nickel Company. "Some New Alloy Steels and Their Heat Treatment"
Round Table Discussion of Apprenticeship Program

1:00 P.M.—Group Luncheon

Noon—Ladies' Bridge Luncheon—Mrs. Horace Knerr, Hostess

2:30 P.M.—Business Meeting—Committee Reports—Mirror Room

6:30 P.M.—Reception and Banquet—Mirror Room

Sunday—October 19—

Morning—Luncheon at Metlab Company Plant—Ladies Invited

Afternoon—Reception and Clambake—President Walter Rex's Home—Ladies Invited

Sunday, devoted to recreation, provided two enjoyable highlights of the Annual Meeting. As can be seen by the program these consisted of an outdoor buffet and plant visitation at the Metlab Company. Host, Horace Knerr, provided an enjoyable repast and also saw to it that those interested could view his plant and equipment.

Later in the afternoon specially chartered busses drove the group to Walter Rex's pleasant farm by way of Valley Forge. At the farm a wonderful clambake with all the trimmings was served in a section of a barn specially prepared for the purpose.

As can be seen from the snapshots everyone had a merry and appetite-satisfying time.

J. W. Rex Co. Metal Show Exhibit

MTI SPRING MEETING

It was decided by the group during the general business session, upon the recommendation of the Spring Meeting Committee, that the 1953 meeting be held at the Shamrock Hotel in Houston, Texas, May 17, 18 and 19.

Vice-President Clifford Cook generously volunteered to assist in making the necessary arrangements. A truly pleasant and worth while meeting is thereby assured.

MTI MEMBERS EXHIBIT IN METAL SHOW

Two members of the Metal Treating Institute had prominent and attractive exhibits in the National Metal Show held in the Auditorium in Philadelphia the week of October 20th. These members were The J. Walter Rex Company, Lansdale, Pennsylvania, and the Metlab Company, 1000 East Mermaid Lane, Philadelphia 18, Pennsylvania. Photographs of these exhibits are shown.

J. W. Rex Company of Lansdale presented an attractive booth of modernistic design, showing various phases of their heat treating and metal conditioning services. Walter Rex also made his booth available as headquarters for the Institute and its membership.

Metlab Co. emphasized human interest by presenting in person "One Grand Mermaid," the advertising slogan derived from its unusual address—1000 E. Mermaid Lane, Philadelphia. An attractive young lady (see photograph) on a sunny, sandy beach, complete

(Continued on page 22)

METLAB CO. METAL SHOW EXHIBIT

Left side of booth staging "One Grand Meramid," who suggested to customers that they relax and let Metlab worry about heat treating problems.

Right side of same booth exhibits some tough heat treating jobs satisfactorily solved by Metlab Co.

"One Grand Mermaid" in person, showing how to enjoy a vacation in Bermuda while the Commercial Heat Treater takes care of your work.

with boardwalk, ocean view and Bermuda palms, dispensed souvenirs including the notorious rubber dollars, to throngs who were then promptly coralled into greener pastures (an artificial lawn) where they were exposed to the influence of the Company's sales staff and an exhibit illustrating the plant, its equipment, and unusual products treated. The Company estimated that 10,000 people visited its booth.

The show, sponsored by the American Society for Metals, was quite interesting and extremely well attended. Member exhibitors expressed themselves as being particularly satisfied with the results.

Both exhibitors included a display promoting METAL TREATING and as a result, nearly 500 visitors interested in the heat treatment of metals requested that METAL TREATING be sent to them regularly.

COUNCIL OF PROFIT SHARING INDUSTRIES

"Economic Unity"

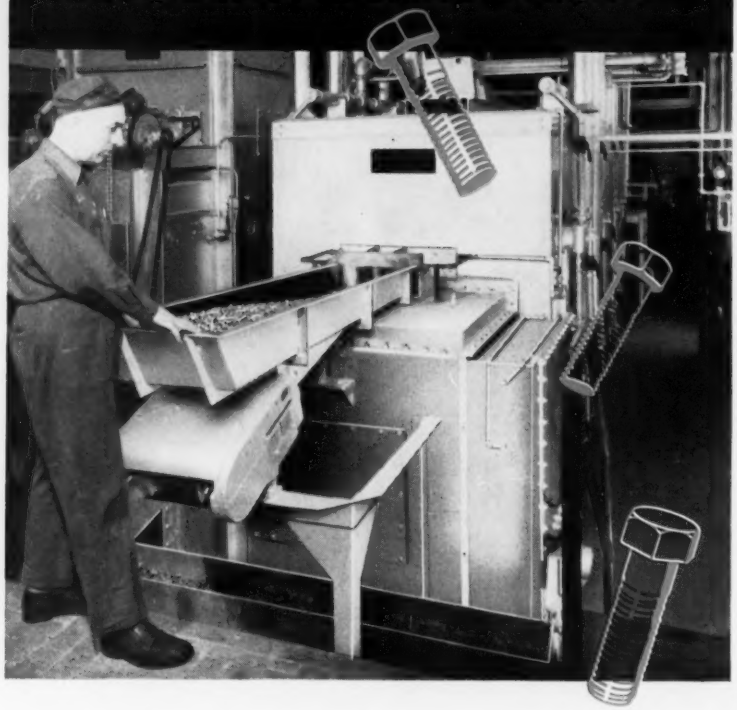
One reason for the great depression and for the dangerous trend towards centralized, autocratic government which grew out of it, was the failure of American industrialists to appreciate the necessity for social progress and to make effective measures to promote it. We did not, in sufficient numbers, comprehend the need for reforms and take the initiative ourselves to bring them about. Therefore, a resentful populace, by political action, caused changes which, while good in some respects, threatened to reach extremes endangering the survival of our free economy. This must not happen again.

This was the keynote and theme of the 5th Annual Conference of the Council of Profit Sharing Industries. This small, but fast growing group of farsighted, practical men, from industries of every variety and size, held their meeting in Philadelphia, November 6th and 7th. Their common interest is a plan of action to bring about the industrial unity and to strengthen America's system of free com-

(Continued on page 23)

HEAT TREATING

1000 pounds of Bolts every hour



. . . at Commercial Steel Treating Corp., Detroit

Production heat treating of bolts—1000 pounds each hour—at Commercial Steel Treating Corp., Detroit, is accomplished in this Holcroft furnace which clean hardens, case hardens or restores carbon.

All operation, except for loading is fully automatic. Bolts are loaded into a vibrator and carried through the furnace on an endless belt conveyor. The stock is carried from the quench, across to the washer and tempering furnace, returning to a position near the loading vibrator. Furnace atmosphere is provided by a Holcroft endothermic gas generator.

Gas-fired radiant tubes—easily replaceable without furnace shut down – heats the hardening furnace. Also included in the arrangement is a Holcroft direct-fired, recirculating type conveyor furnace for tempering as high as 1200 deg. F.

This is just another example of Holcroft's heat treat leadership. We can supply you, too, with a high-capacity, low-cost furnace —designed with your production in mind. Write today.

SINCE 1916 Holcroft AND COMPANY

PRODUCTION HEAT TREAT FURNACES FOR EVERY PURPOSE

6545 EPWORTH BLVD. DETROIT 10, MICHIGAN

The Effect of Structure on Machining Characteristics of Steel (cont.)

speed with carbide tipped tools, using negative rake, a spheroidized structure works the best, even in the lower carbon ranges. There are not a great nnmber of such machines in operation, however.

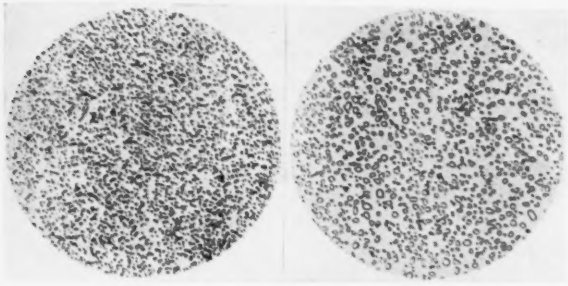


Fig. 4

Fine spheroids Moderate sized spheroids

The improvements made in annealing equipment in the past few years enable the heat treater to yield a structure or a combination that will suit the end use. It then remains for machining people to place their orders on a structure basis with less regard to hardness.

Institute News (cont.)

petitive enterprise under an enlightened capitalism, so that it may rise to new levels of production, establish higher standards of living for all, and demonstrate for the entire world the advantages of our system as compared with the insidious philosophy of Communism which now controls more than half of the globe and which will certainly destroy us if we do not establish our superiority.

The Council of Profit Sharing Industries is composed of some 600 firms which reject the idea that the interests of Industry and Labor are opposed. They believe, and have proved, that all the employees of a concern, from top to bottom, can and should work together as one team, mutually striving toward the same goal of greater accomplishment and greater rewards for all.

There are many forms of profit sharing but all have the purpose of making the interests of the employee and the employer the same. They are not two opposing teams trying to beat each other.

Prominent speakers included James F. Lincoln, President, Lincoln Electric Company; Lucas S. Miel, President, Commercial Steel Treating Company of Detroit, who was also elected first vice president of the Profit Sharing Council; Dr. Daniel A. Poling, editor and humanitarian; George Baldanzi, Director of Organization, United Textile Workers of America, A.F.L.; M. S. Rukeyser, economist for the Hearst newspapers; Lansing P. Shield, President, Grand Union Co.; Harry Weiss, Executive Director, Wage Stabilization Board, Washington, D. C.; and many others.

Members of M.T.I. interested in the movement are Luke Miel of Commercial Steel Treating Co., J. Walter Rex of J. W. Rex Co., Purdy Benedict of Benedict-Miller Company, Horace C. Knerr of Metlab Company, and Frank Rizzo, L-R Heat Treating, Inc.

DEVINE AGITATORS

ASSURE

UNIFORM QUENCHING TEMPERATURES

- Provide proper circulation of quenching liquid.
- Help equalize quenching strains.
- Compact. Self-contained. No piping required.
- Unusually sturdy. Built for plenty of use.
- Easy to install. Easy to detach. Easy to maintain.

Devine Engineers will be glad to recommend a type and size to fit your tank.

J. P. DEVINE MFG. CO.

A. M. Cox, President

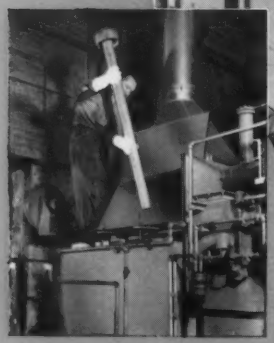
49th St. and AVRR · Pittsburgh 1, Pa.

Devine AGITATORS

Here's the new...

LINDBERG CARBONITRIDING FURNACE

It's many-furnaces-in-one! • It's designed not only for carbonitriding . . but also for hardening, carburizing, annealing and carbon restoration! • It's a self-contained unit! • It's easy to maintain!



Change tubes like the blades in your razor! It's easy to change the new thin-wall tubes—just lift 'em out and hang new ones in place . . . all in a matter of minutes.

The greatest advance in industrial furnace design and construction since Lindberg introduced the Cyclone forced convection tempering furnace back in 1935!

A 320 lb. load of CRS sleeves. Carbonitrided .010 to .015". 90 minutes in heating chamber. Temperature, 1600° F.

A 400 lb. load of CRS hex nuts. Carbonitrided .001 to .005". 60 minutes in heating chamber. Temperature, 1600° F.

Yes, you must see the new Lindberg Carbonitriding Furnace. It's many furnaces in one . . . it's easy to maintain . . . it's a self-contained unit.

Check these important construction features . . . features that will improve production quality and volume, and reduce production costs.

Many furnaces in one . . . Furnace atmosphere is provided by the Lindberg "Hyen" endothermic atmosphere generator that is easily adjustable to supply different atmospheres not only for carbonitriding, but also for carburizing, carbon restoration, bright hardening or annealing and normalizing. For annealing and normalizing the heated charge cools in the same chamber used for purging.

Easy to maintain . . . Instead of old style, heavy, unwieldly, horizontal radiant tubes . . . new gas-fired, lightweight tubes (only 29 pounds) are used. They're simple to change . . . turn off the gas . . . get on top the furnace . . . lift out the old tube . . . hang a new one in its place . . . and the thin, rolled metal tubes actually last longer!

Quench tank pit unnecessary . . . Your Lindberg Carbonitriding Furnace is self-contained, including a built-in pitless quench tank . . . thus you avoid costly excavation and piping. But more important, this built-in quench tank minimizes distortion . . . quenching takes place within the furnace structure, by means of a vertically operated elevator. Heated charges are never exposed to the air . . . as is the case when work is transferred from the heating chamber to a separate quench tank. Uniform case depth is assured because each charge automatically remains at heat the same length of time.

Purge chamber . . . A specially designed chamber, built immediately above the quench tank and in front of the heating chamber, receives work load for purging prior to heating.

For full details ask for Bulletin 241

A 120 lb. load of CRS screws. Carbonitrided .005 to .008". 45 minutes total time...temperature, 1580° F.

Lindberg Engineering Company

2466 W. Hubbard Street, Chicago, Illinois

LINDBERG FURNACES

LETTERS TO THE EDITOR

Dear Editor:

In your September-October issue of Metal Treating an article on Impregnation under the heading of Impregnation Seals Porous Castings by Conrad H. Knerr, we would appreciate receiving five thousand (5000) copies of this article for distribution to our Sales Representatives.

At this time we wish to compliment you on the results obtained through your publication on our advertisements which have appeared during the past year on Devine Agitators. The results have been most gratifying and we intend to continue and increase our advertising space for next year.

Incidentally, we are at present preparing an advertisement to appear in your next publication featuring "Devine Impregnators for Casting Impregnation."

H. A. McCOY
Sales Manager
J. P. Devine Manufacturing Co., Inc.
Pittsburgh 1, Pa.

Dear Editor:

It has been our custom to advertise by mailing samples of our printing – book jackets, brochures, circulars, and fine color reproductions.

For our next advertising piece, we have selected the September-October issue of Metal Treating.

Your utmost cooperation in the selection of paper, color, layout, and printing has done much to make us extremely proud of the Metal Treating publication.

MICHAEL CARDINER
President
Federated Printing Company, Inc.
New York 18, N. Y.

Dear Editor:

We ask that you kindly place the name of our exclusive Dutch agent on your mailing list so that they will receive a copy of "Metal Treating."

N. V. Rotterdamsche Machinehandel, Esmeijer & Co., Oosterkade 24, Rotterdam-C, Holland.

Esmeijer & Co. have represented us in Holland for approximately 25 years and we feel confident that your publication would be of great value to them.

B. STEVENS
Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.
New York 17, N. Y.

Dear Editor:

We will appreciate your placing our name on your mailing list, so that we will continue to get your informative and interesting publication.

F. V. HORAK
Metallurgist
Allis-Chalmers Manufacturing Company
Milwaukee 1, Wis.

Dear Editor:

I have just finished reading the September-October issue of Metal Treating.

It is the first copy that I have seen and I find it very interesting and helpful and would appreciate receiving each issue as printed.

The Syracuse Heat Treating Corp. of 1223 Burnett Avenue, Syracuse, New York, has been very helpful to us on considerable high speed steel tools.

W. N. EVANS
Superintendent
Ithaca Gun Company, Inc.
Ithaca, N. Y.

Dear Editor:

We should like to be placed on your mailing list for "Metal Treating." We feel certain that it will be of great assistance to our organization. Should there be any charge involved, please advise us. Thank you for your cooperation.

R. W. MULLER, JR.
President
Shop Equipment Company
New York 11, N. Y.

Dear Editor:

Would you please be so kind as to place me on your mailing list. Being foreman in charge of a large heat treat plant in Burbank, California, I would appreciate very much receiving your publication called "Metal Treating." Thanking you so much, I remain,

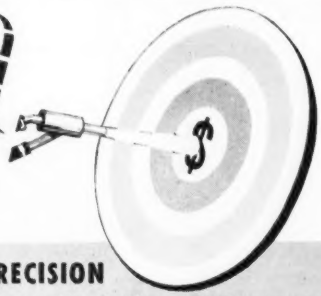
JOHN THOMAS RICHARDS
Pacoima, Calif.

Dear Editor:

We have received the May-June 1952 issue of Metal Treating, and sincerely thank you. Please continue sending subsequent issues.

N. M. HUDAK
Chief Engineer
The Trawood Engineering Company
Cleveland, Ohio

a $ure $hot for $avings



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The Liquamatte is easier to start and more convenient to operate. Work can be handled faster with less effort and with far less down time. As a result, the Liquamatte uniformly removes scale and grinding lines at a new low cost. It cleans tools, dies and molds with greater efficiency while holding tolerances of .0001".

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Typical heat treated forging die, one half of which has been cleaned with the Liquamatte using a fine mesh Liquabrasive.

THE 14 WAYS the Liquamatte simplifies wet blasting are described in Bulletin 23. Send for your copy today.

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855 S. Byrkit St., Mishawaka, Indiana

Heat Treating Abstracts

(From a paper: "Continuous Annealing With Carbon Restoration," by J. D. Armour, Chief Metallurgist, Union Drawn Steel Division, Republic Steel Corporation.)

Continuous Carbon Restoration During Annealing

Many compromises between the theoretical and practical concepts of carbon restoration have resulted in a new furnace which makes practical the continuous carbon restoration and annealing of steel in one operation at relatively high production rates. The furnace has been installed in the plant of Union Drawn Div., Republic Steel Corp., and represents a cooperative development of that company and Surface Combustion Corp.

It had previously been established that carbon restoration could be done with equal success either during final hardening or annealing and with some economic advantages on the side of carrying on the operation during the annealing process.

The new furnace is used to supplement the normal carbon restoration equipment in the plant and is restricted to certain work. Bars up to 6 in. in diameter and wire coils up to 54 in. in diameter are treated in it. On work handled thus far production increases of as much as 240% have been recorded, due chiefly to the tremendous saving in time that can be achieved.

Secret of the success of the furnace lies in its combination of the inherent advantages of continuous operation with precise atmosphere control conditions necessary for carbon restoration. The furnace consists of six zones, each 10 ft. long. Each zone is independently controlled, allowing the flexibility of temperature demanded by isothermal annealing. Each zone has independent atmosphere inlets and recirculation fans, making each zone almost independent of adjoining zones as far as atmosphere is concerned, thus providing precise control of carbon potential.

Two types of prepared atmosphere gases are used to provide closer control and present an answer to the problem of carbon build-up and sooting in the furnace. RX gas, plus some natural gas for enrichment, is used to maintain the carbon potential in the high temperature zones. During cooling from the austenitizing temperature and at the lower holding temperature, an inert atmosphere (NX) is mixed with the carbon balanced atmosphere from the hot zones. In this manner, the carbon potential is reduced during cooling, thus eliminating high surface carbon on the bars and furnace sooting.

Further control over the furnace atmosphere is provided by properly placed atmosphere inlets, adjustable throats on either end of the furnace, water cooled doors, effective air curtains and recirculating fans. Time in the furnace is easily controllable between 1 and 24 hours at temperatures ranging from 1400 to 1800 F.

In addition to attaining proper carbon restoration, the continuous process has made possible other benefits, including the elimination of subsequent operations such as carburizing or cyaniding on certain classes of work.

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125	275	450	1000	1550
138	288	500	1050	1600
150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
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NEW YORK 17, N. Y.

Manufacturers' Literature . . .

The literature listed below contains information of interest to heat treating organizations. For your copy write direct to the manufacturer and be sure you mention seeing it reviewed in "Metal Treating."

SUPER CYCLONE FURNACES

A new 8-page two-color bulletin on Gas-fired and Electric Super Cyclone furnaces has just been issued by Lindberg Engineering Company.

The bulletin contains photographs, diagrams and specification charts on all types of "Lindberg Super Cyclones."

Operation, design features and the wide range of uses for annealing, normalizing, tempering, nitriding and special heating are briefly explained.

Request your copy of Bulletin No. 131 from Lindberg Engineering Company, 2450 West Hubbard Street, Chicago 12, Illinois.

ANARUST: A LIQUID RUST INHIBITOR FOR WET BLASTING MACHINES

American Wheelabrator & Equipment Corporation, 1175 South Byrkit Street, Mishawaka, Indiana, announces that Anarust, a liquid rust inhibitor for wet blasting machines, is available from stock.

Anarust is a material of organic composition, and it contains no chromates. It is completely soluble in hard or soft water at 20 degrees Centrigrade, and it produces a clear colorless solution, which is odorless, non-irritating to the skin, and not subject to bacterial decomposition.

When used at the rate of approximately ½ ounce per gallon of water, it is a very effective agent in retarding rust on cast iron or steel parts which are being cleaned and washed after wet blasting. It can also be safely used on parts prior to undergoing such operations as plating, enameling, painting, etc.

TUNNEL BURNER ASSEMBLIES

The Hauck Manufacturing Company, 124-136 10th Street, Brooklyn, New York, has prepared a new catalog #807 on the subject of Tunnel Burner Assemblies for heat treating furnaces of various types. The bulletin provides capacities and dimensions for either artificial or natural gas and describes the manner whereby time and labor economies can be provided through the use of complete units.

HIGH FREQUENCY HEATING UNIT

The Lepel High Frequency Laboratories, Inc., 39 West 60th Street, New York 23, New York, has published a four-page bulletin describing their model T frequency induction heating unit of the electronic tube type. The equipment is described as being suitable for both ferrous and non-ferrous metals to any desired temperature. Output rating is 20 KW.

THERMOCOUPLES — PARTS — ACCESSORIES

The Leeds & Northrup Company, 4907 Stenton Avenue, Philadelphia 44, Pennsylvania, has published catalog EN52 which contains 45 pages describing their line of thermocouples as well as various parts and accessories. The book contains descriptions of special units for both general and specialized applications in specific industries.

HOW TO USE TEMPERATURE SENSITIVE LIQUID

"Instructions for Using Tempilaq°" contains much information on how this temperature sensitive liquid can most effectively be employed to determine attained temperatures is published by Tempil° Corporation, 11 W. 25th Street, New York 11, N. Y. A number of special techniques are discussed. Among them are:

Recommended procedure for the use of a "faint haze" on glass (radio power tubes) or other highly polished surfaces.

Method of assuring adherence to Tempilaq° to fast-moving or rotating surfaces, or to surfaces subjected to high gas velocities.

The effect of evaporation of Tempilaq° at temperatures considerably higher than its assigned rating.

Adapting the thickness of the Tempilaq° coating to special conditions.

The effect of reducing atmospheres on the accuracy of Tempilaq°.

NEW TACHOMETER BULLETIN

A new bulletin describing its full line of recording and indicating electric tachometers has just been published by The Bristol Company, Waterbury, Conn. The instruments described include models for measuring speed of rotation or travel, processing time, speed ratios, sum or difference of speeds, and average of speeds. Featured in the bulletin are the recently-announced electronic Dynamaster Recording Tachometers. Engineering information and complete specifications on magnetos and the various types of magneto drives are given. The 20-page bulletin, No. S1402 is liberally illustrated with photos and drawings showing methods of application, reproductions of actual chart records, and dimensions.

AUTOMATIC VOLTAGE STABILIZERS

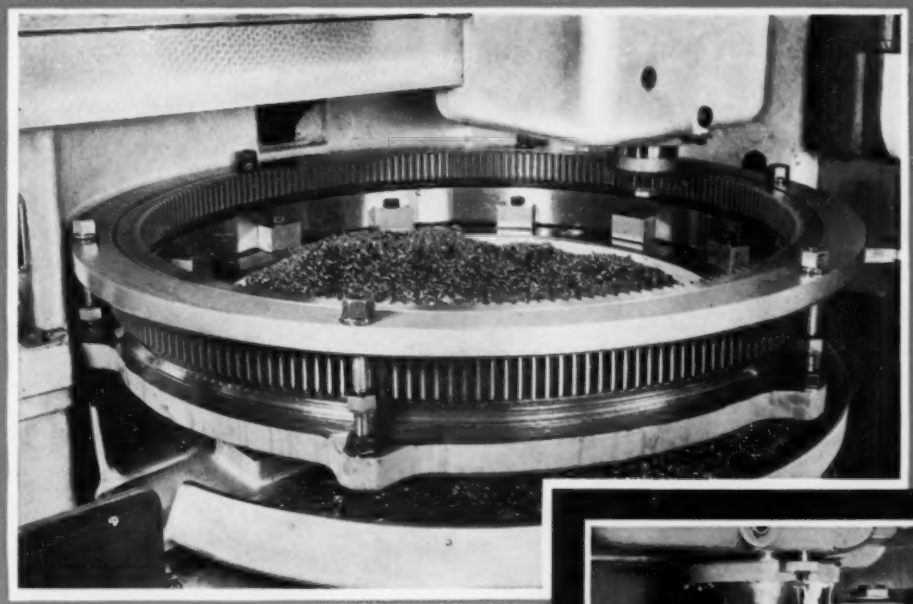
A new 12-page, two-color bulletin on automatic voltage stabilizers ranging from 15 to 5,000 volt amperes has been announced as available from the General Electric Company, Schenectady 5, New York.

The booklet (GEA-5754) contains photographs and diagrams of the equipment, explains operation principles and construction, and gives complete specifications. It also describes the causes and effects of voltage variations and lists typical applications for stabilizers.

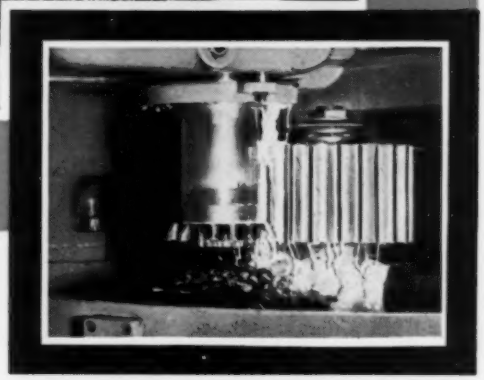
COMPLETE LABORATORY SUPPLY CATALOGS

Scientific Glass Apparatus Co., Inc., Bloomfield, New Jersey, has just announced the publication of two new catalogs. One, known as the "General," has one thousand pages illustrating and describing a complete line of scientific instruments, apparatus and general laboratory glassware and supplies. The second, entitled "Inter-Joint" Glassware, contains four hundred twenty pages covering their entire line of manufactured glassware, both standard and special.

Copies may be secured by filling out a "Catalog Requisition Form" obtainable from the Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.



Fellows 36-type Gear Shaper set up to cut a heavy-pitch spur gear.



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For no other heat treating compounds tried gave such uniform, clean, decarb-free work — or, for manufacturing economy, longer electrode life.

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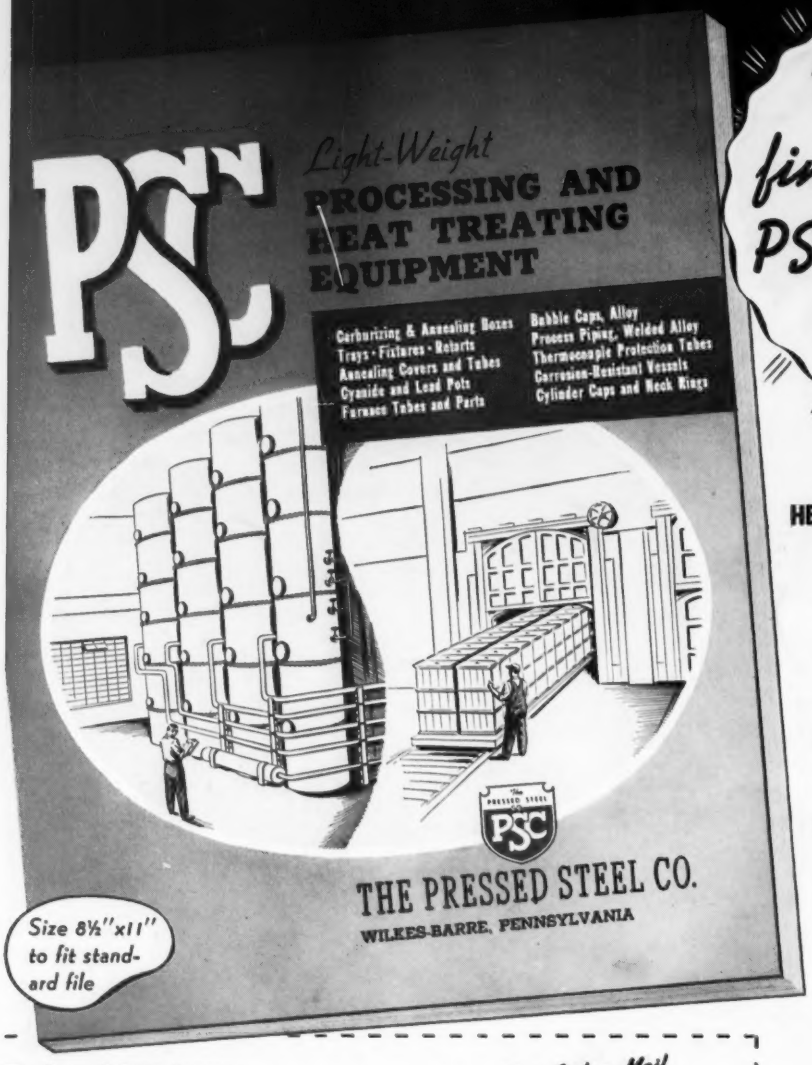

You will find the new PSC CATALOG helpful

CLASSIFICATIONS OF PSC HEAT AND CORROSION-RESISTANT INDUSTRIAL EQUIPMENT

Baskets, annealing & carburizing
Baskets, cyanide dipping
Baskets, pickling
Bends, alloy pipe & tubing (welding)
Boxes, annealing & carburizing
Caps, bubble (fractionating tower & still)
Caps, cylinder (compressed gas)
Covers, annealing (Bell furnace)
Covers, annealing (elevator furnace)
Fixtures, carburizing
Flights, conveyor (syn. rubber plant)
Headers, air pre-heating
Manifolds, gas exhaust
Muffles, carburizing
Piping, process (alloy only)
Pots, carburizing & annealing
Pots: lead, cyanide & salt
Racks, annealing & carburizing
Racks, sheet pickling
Retorts, carburizing
Rings, neck (compressed gas cylinder)
Tanks, copper annealing
Tanks, pickling
Trays, annealing & brazing
Tubes, annealing
Tubes, furnace vent
Tubes, radiant furnace
Tubes, thermocouple protection
Tubing, corrosion & heat resistant
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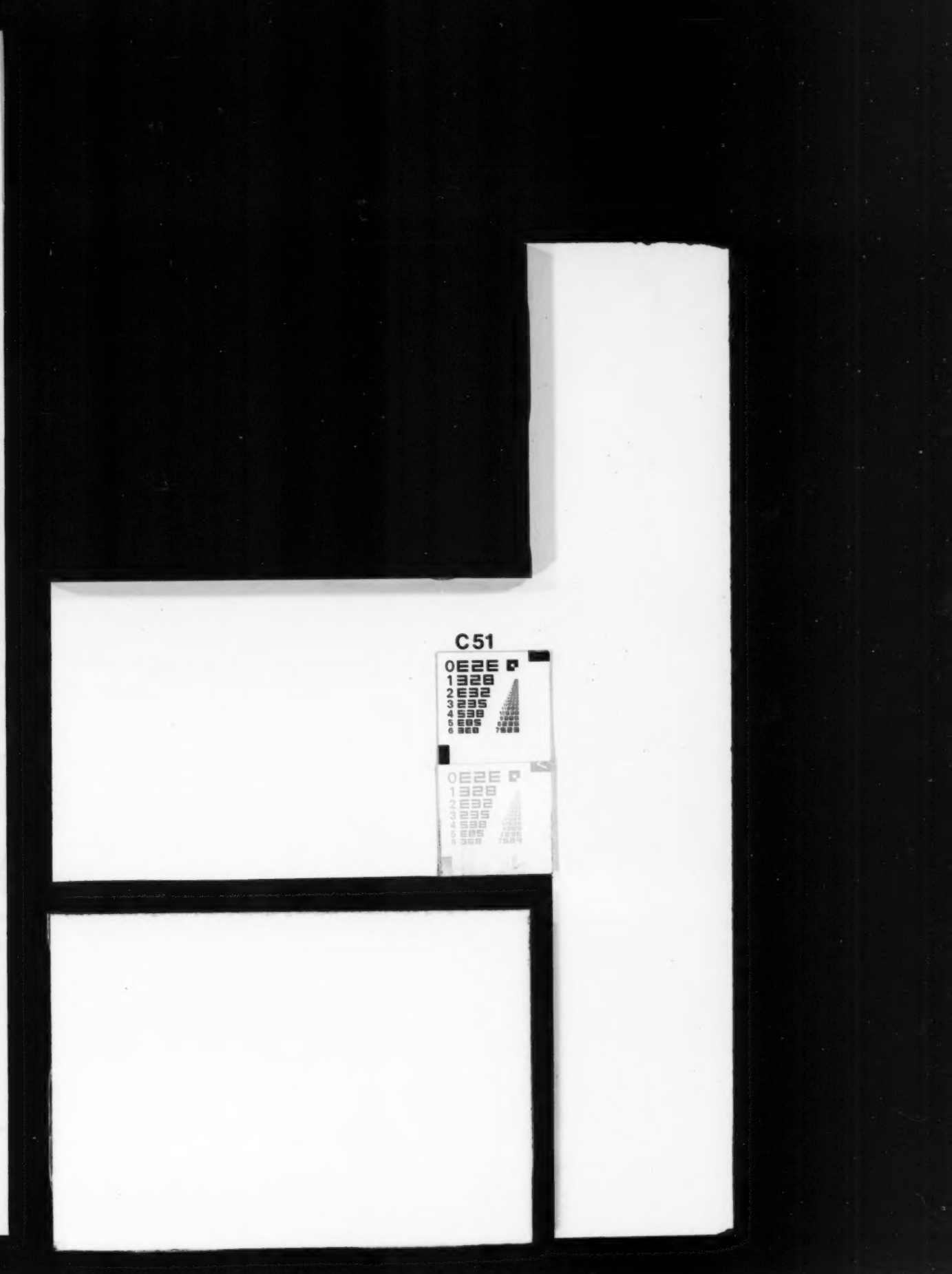
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